

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.

1. REPORT DATE (DD-MM-YYYY)

2. REPORT TYPE
Technical Papers

3. DATES COVERED (From - To)

4. TITLE AND SUBTITLE

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Air Force Research Laboratory (AFMC)
AFRL/PRS
5 Pollux Drive
Edwards AFB CA 93524-7048

8. PERFORMING ORGANIZATION
REPORT

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Air Force Research Laboratory (AFMC)
AFRL/PRS
5 Pollux Drive
Edwards AFB CA 93524-7048

10. SPONSOR/MONITOR'S
ACRONYM(S)

11. SPONSOR/MONITOR'S
NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release; distribution unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

20020823 050

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:

17. LIMITATION
OF ABSTRACT

18. NUMBER
OF PAGES

19a. NAME OF RESPONSIBLE
PERSON

Leilani Richardson

a. REPORT

b. ABSTRACT

c. THIS PAGE

Unclassified

Unclassified

Unclassified

A

19b. TELEPHONE NUMBER
(include area code)
(661) 275-5015

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

41 items enclosed

5B

MEMORANDUM FOR PRS (In-House Publication)

FROM: PROI (STINFO)

30 August 2001

SUBJECT: Authorization for Release of Technical Information, Control Number: **AFRL-PR-ED-TP-2001-178**
McFall, Keith , "AIAA Highlights - Propulsion and Energy: Solid Rockets"

AIAA 2001 Highlights
Journal Article (Deadline: 05 Sep 2001)

(Statement A)

1. This request has been reviewed by the Foreign Disclosure Office for: a.) appropriateness of distribution statement, b.) military/national critical technology, c.) export controls or distribution restrictions, d.) appropriateness for release to a foreign nation, and e.) technical sensitivity and/or economic sensitivity.

Comments: _____

Signature _____ Date _____

2. This request has been reviewed by the Public Affairs Office for: a.) appropriateness for public release and/or b) possible higher headquarters review

Comments: _____

Signature _____ Date _____

3. This request has been reviewed by the STINFO for: a.) changes if approved as amended, b.) appropriateness of distribution statement, c.) military/national critical technology, d.) economic sensitivity, e.) parallel review completed if required, and f.) format and completion of meeting clearance form if required

Comments: _____

Signature _____ Date _____

4. This request has been reviewed by PRS for: a.) technical accuracy, b.) appropriateness for audience, c.) appropriateness of distribution statement, d.) technical sensitivity and economic sensitivity, e.) military/national critical technology, and f.) data rights and patentability

Comments: _____

APPROVED/APPROVED AS AMENDED/DISAPPROVED

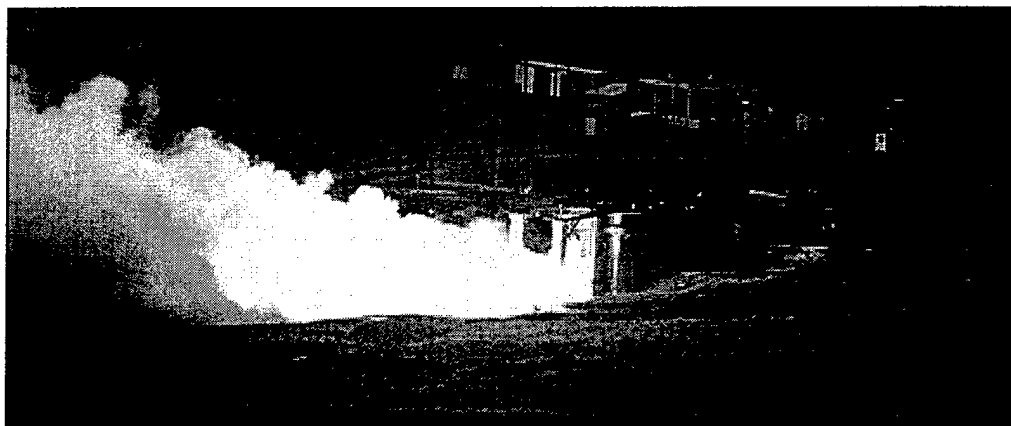
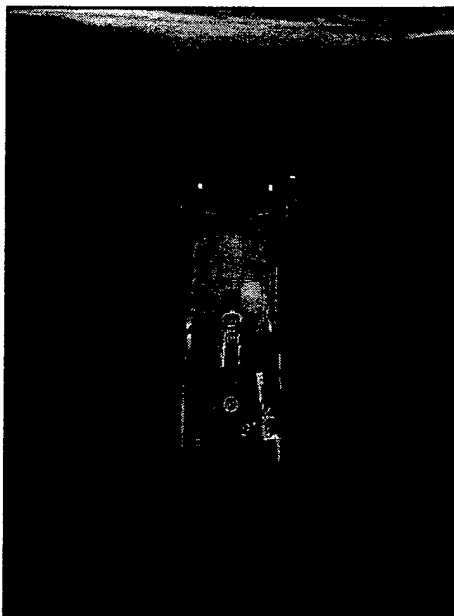
PHILIP A. KESSEL Date
Technical Advisor
Space & Missile Propulsion Division

AIAA 2001 Highlights - Propulsion and Energy: Solid Rockets

Air Force Research Laboratory Propulsion Directorate Input

On November 16th, 2000 the culmination of an aggressive 23 month, jointly funded Integrated High-Payoff Rocket Propulsion Technology (IHRPT) Phase I Missile Propulsion program by the Air Force Research Laboratory Propulsion Directorate and Alliant Techsystems resulted in a highly successful full-scale rocket motor demonstration. This motor contained the most new technology on any one demonstration since the Trident I (C4) 25 years ago. The full-scale test incorporated new case, propellant, nozzle, and control technologies in a 92 inch diameter, 120,000 pound class motor, and verified achievement of the Phase I program specific impulse, mass fraction, and cost goals. The technologies that were demonstrated have the potential to yield a 23% increase in payload capability at a 32 % lower cost for solid booster space lift applications are ready for transition into strategic missiles, small and large launch vehicles as stages or strap-on boosters.

The IHRPT Phase I Missile Propulsion demonstration is the first in a series of tests that are part of a three phased, government and industry coordinated effort that began in 1996 with the vision to double the propulsion capability by 2010. The Phase II programs, awarded during the past year, are part of the government/industry Technology for the Sustainment of Strategic Systems (TSSS) effort to maintain critical technology capability.





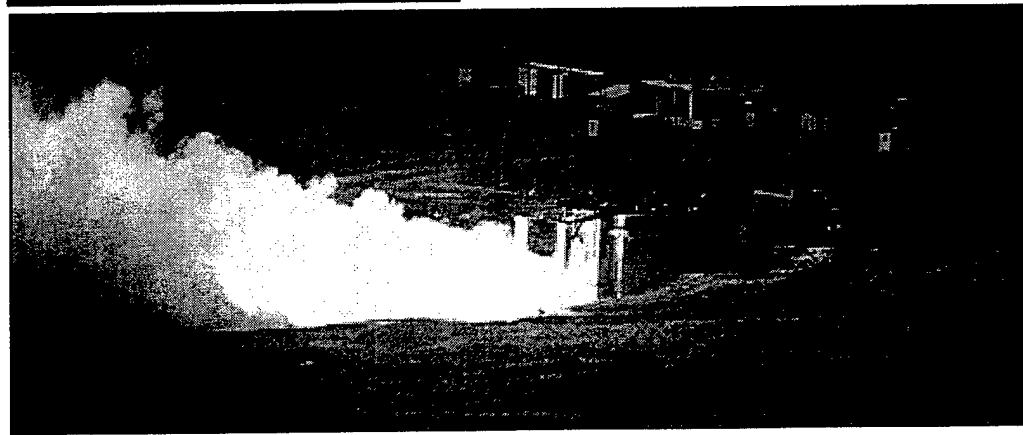
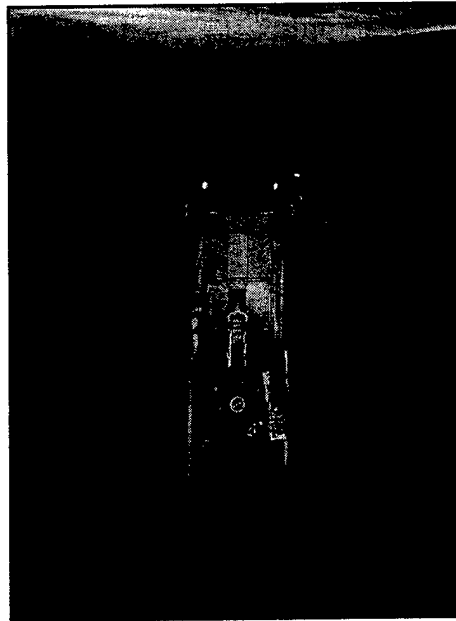
Reference

Air Force Research Laboratory | AFRL

Science and Technology for Tomorrow's Aerospace Force

Success Story

IHPRPT PHASE I SOLID BOOST
DEMONSTRATOR A SUCCESS!



On 16 November 2000, the culmination of an aggressive 23-month Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program, jointly funded by the Air Force Research Laboratory Propulsion Directorate and Thiokol Corporation, resulted in a highly successful full-scale solid rocket motor demonstration.

DRAFT

Alliant's GEM-60 booster was qualified in just 29 months. (Photo courtesy Alliant Techsystems.)

PROPULSION AND ENERGY

Solid rockets

- This year was one of corporate change in the U.S. solid rocket industry. In May, Alcoa completed the purchase of Cordant Technologies, the parent company of Thiokol Propulsion. Thiokol is now part of Alcoa's Industrial Components Group. And, in a move that could signal the beginning of a long-expected consolidation of the industry, Pratt & Whitney and GenCorp Aerojet announced their intent to form a new space propulsion company that will combine their respective capabilities in both liquid and solid propulsion.

Solid stages for ICBM fleet

Significant work continued this year on the aging surveillance and upgrade of solid propulsion stages for the U.S. ICBM fleet. Thiokol Propulsion and the Pratt & Whitney Space Propulsion Chemical Systems Div. (CSD) are jointly providing sustaining engineering services for Minuteman and Peacekeeper solid stages under TRW's ICBM Prime Integration Program. The joint venture began low-rate initial production remanufacture of all three Minuteman stages, coincident with successful static testing and the May 24 flight test of an unarmed missile with three fully refurbished stages.

On March 2, Thiokol successfully static fired a 14-year-old Peacekeeper Stage I—the oldest Peacekeeper motor tested to date. A converted Peacekeeper first stage also boosted an Orbital Sciences (OSC) Taurus launch vehicle on March 12. The first-ever launch of an Atlas IIAS vehicle from Vandenberg AFB, Calif., took place on February 3 and used four Thiokol Castor IVA strap-on solid boosters, continuing a record of 100% launch success since 1993.

Four-stage all-solid propulsion boosted OSC's Minotaur small launch vehicle to a successful debut this year. Minotaur uses Alliant Techsystems (ATK) Orion 50 and Orion 38 motors placed atop decommissioned M57A1 and SR19 Minuteman stages. ATK's Orion family of rocket motors entered its second decade of successful flights for the Pegasus/Taurus vehicle family. GenCorp Aerojet received a follow-on contract to continue its modification of SR19 nozzle vectoring systems for the Air Force's Reentry System Launch Program.

Reference



AFRL section

Other military efforts

As part of the Integrated High-Payoff Rocket Propulsion Technology initiative, the Air Force Research Laboratory Propulsion Directorate at Edwards AFB, Calif., and Thiokol Propulsion have planned the static test of a solid motor that is expected to meet or exceed Phase I program goals for total impulse, reduced weight, and cost. An Air Force/industry team also continues work on the Technology for the Sustainment of Strategic Systems effort to address issues associated with missile propulsion, aging and surveillance, and postboost propulsion.

Following successful qualification in 1997, Atlantic Research (ARC), a unit of Sequa, began production of the Mk 112 motor for the Navy's Rolling Airframe Missile (RAM) this year. RAM is a lightweight, quick-reaction antiship missile similar to the Sidewinder air-intercept missile. Under a new multiyear contract from the Army to the Raytheon/Lockheed Martin joint venture, ARC continued production of the solid propulsion unit for the man-portable Javelin antitank weapon. ARC solid propellant booster and attitude control motors also powered the Patriot Advanced Capability-3 missile to successful intercept tests on February 5 and July 22, and an Army Tactical Missile System rocket to a successful development flight test of its Block II antiarmor submunition on August 30.

The Navy successfully conducted the first two controlled test flights of the Standard Missile-2 (SM-2) Block IVA for its Navy Area-Wide program on June 29 and August 24 at White Sands Missile Range. The SM-2

by Thomas L. Moore

Block IVA uses a CSD-produced Mk 72 booster with an ARC Mk 104 dual-thrust rocket motor. They were the first of eight scheduled engineering and manufacturing development (EMD) flight tests to be conducted over the next 18 months. SM-3, being developed for Navy Theater-Wide applications, adds a Thiokol-developed third-stage rocket motor (TSRM) that successfully completed a series of critical qualification static firings at simulated altitude conditions in May and June. The Mk 136 TSRM is the first pulse motor to be developed in the U.S. for an upper-stage application.

In July, the Army Space and Missile Defense Command awarded the EMD contract for the Theater High-Altitude Area Defense (THAAD) missile defense system to Lockheed Martin. This followed on the heels of CSD's successful June 26 static test of a THAAD booster motor at -25.4 F, the coldest THAAD motor ever tested and the last key milestone before transition to EMD.

Space activities

For the first time since June 1998, Thiokol conducted a static test of its reusable solid rocket motor (RSRM) used for the Space Shuttle. The successful February 17 test served to evaluate current RSRM components as well as new materials and processes that are being incorporated into its manufacture. Three additional ground tests are scheduled to support RSRM production through May 2005.

The team of Alliant Techsystems and Astrotech Space Operations developed and tested the Oriole, a 22-in.-diam, 154-in.-long graphite epoxy motor (GEM-22) being proposed for use as a stage of a new, low-cost suborbital rocket for NASA's sounding rocket program and as a possible target vehicle. ATK's successful 32-sec static firing on April 20 was followed by the successful July 7 launch of a Terrier-Oriole suborbital rocket from NASA's Wallops Flight Facility in coastal Virginia.

Air Force Titan IVB vehicles with twin ATK Solid Rocket Motor Upgrade (SRMU) boosters successfully launched U.S. defense satellites on May 8 and August 17. Also, the fifth and final scheduled qualification static firing of an SRMU was conducted on March 19 at Edwards AFB. The successful 140-sec firing of the 126-in.-diam, 112-ft-long SRMU validated new materials and processes used to manufacture the booster's carbon-phenolic nozzle.

With successful static tests on April 27 and June 22, ATK also completed qualification of the latest addition of its family of intermediate space boosters, the 60-in.-diam GEM-60. Two or four GEM-60 motors will be attached to the common booster core of Boeing's three Delta IV medium-plus vehicle configurations. Delta IV's maiden launch is scheduled for 2001. GEM-60's legacy motors, the GEM-40 and GEM-46, are in active use as strap-on boosters for Delta II and Delta III, respectively. The successful Delta II launch on May 11, which placed a GPS satellite in orbit, marked the 100th successful flight of Thiokol's Star 48 upper stage motor.

European programs

On the European front, Snecma Moteurs of France successfully completed the static test qualification of two new nozzle materials. One is a low-cost carbon-carbon for throat components; the other is a carbon cloth phenolic (CCP) for insulators and exit cone liners. The new CCP, developed in response to the loss of a supplier of aerospace-grade rayon, is obtained from a standard-grade rayon and is carbonized using a Snecma Moteurs patented process. Fiat Avio conducted two successful firings of its composite-cased Zefiro motor, the second stage for the planned European small launcher Vega.

On May 16, a successful 140-sec static test of a modified Ariane 5 solid booster was conducted at the Guyana Space Center in French Guyana. The test validated new materials, evaluated nozzle aging characteristics, and qualified the S1 first segment of the motor for an increased propellant loading of 2.5 tons over the current version.

The Propulsion Div. of the Nordic Ammunition Company (NAMMO) completed the development and preflight readiness testing of the rocket motor and jet vane thrust vector control system for a new short-range air-to-air missile. NAMMO has also applied graphite epoxy composite case technology to several initiatives, including the booster motor for the recently qualified NSM long-range antiship missile, the demonstration of a new hypervelocity motor concept, and a ship air-defense missile product improvement effort. ▲



Thiokol's RSRM rumbles the Wasatch range in Utah. (Photo courtesy Thiokol Propulsion.)